James Madison University
Mathematics Colloquium

Singularities in the Elastic Tidal Deformation of Planetary Bodies

Sarah Frey
California State University, East Bay

Wednesday, January 25
3:45
(Refreshments served at 3:35)

Room 030, Burruss Hall

Abstract

In 1911, A.E.H. Love published a linear elastic model for the tidal amplitude of a uniform, compressible, self-gravitating body. Recent numerical evaluations of the solution to his governing equations reveal the surprising result that there exists material parameter values (density, rigidity, and compressibility) for which infinitesimal tide raisers can raise tides of arbitrary height.

Using a solution technique somewhat different from Love's, we investigate the effect of allowing non-uniform, radially varying density and elasticity in Love's formulation. It has been found that the tidal singularities persist when the body has a radially dependent density or elasticity profile. However, we find that the denser a planet is at the center relative to the surface, the more compressible the body must be exhibit singular type behavior. This implies that self-gravitation itself is an unstable process. A nonlinear elasticity theory is used to show that self-gravitation is indeed unstable with respect to non-radial perturbations for particular parameter values.

Dr. Frey is a candidate for a position in mathematics.